Traditional Ecological Knowledge Policy Considerations for Abandoned Uranium Mines on Navajo Nation

Tommy Rock[1] *and Jani C. Ingram*[2]*

ABSTRACT

Environmental justice is a prominent issue for Native American nations within the United States. One example is the abandoned uranium mines on the Navajo Nation that have been left unremediated since the Cold War. Often, environmental policy is developed for issues facing Native American nations that do not include input from those nations. Instead, Native American nations should have the opportunity to address environmental issues using their traditional ecological knowledge (TEK). TEK has ties to natural laws long respected by tribal communities; these laws provide the foundation for addressing the complex relationship between nature and humans. Often, policy development addressing environmental concerns is determined by non-Native American stakeholders, which can have negative effects on the Native American communities. These policies harm Native Americans rather than ultimately helping them. The focus of this discussion is how TEK can play a role in environmental policy development for the Navajo Nation surrounding abandoned uranium mines.

Background on Uranium Mining on the Navajo Nation

Uranium was first mined on the Navajo Nation in Cove, Arizona, in the late 1940s and eventually throughout the Navajo Reservation (Brugge and Goble 2002). Uranium mining operations were established on the Colorado Plateau in many locations, including some in the Four Corners: Arizona (the Carrizo Mountains, Cameron, Blue Gap), New Mexico (Church Rock, Crownpoint, Ambrosia Lake), Colorado (Naturita, Slick Rock, Durango, and Grand Junction), and Utah (Monument Valley, Moab, and Monticello) (Quartaroli 2002). There are over 521 abandoned uranium mines on the Navajo Nation (Navajo AML/UMTRA Department, n.d.).

The past uranium mining on the Navajo Nation is an environmental justice issue, which is defined as a minority or a socioeconomic community burdened with environmental contamination (Cutter 1995). For the Navajo Nation, the environmental justice issue stems from the legacy of abandoned uranium mining. The uranium mining on the Colorado Plateau, particularly on the Navajo Nation, has exposed people living near the mines to a carcinogenic contaminant (Brugge and Goble 2002). Uranium mining is a socioeconomic issue that disproportionately affects poor and disadvantaged minorities: uranium mining brings jobs to communities struggling to find work, despite hazardous exposure to uranium (Eichstaedt 1994), as demonstrated by the high unemployment rate

[1]School of Earth Science and Environmental Sustainability, Northern Arizona University, Flagstaff, Arizona, USA.
[2]Department of Chemistry and Biochemistry, Northern Arizona University, Flagstaff, Arizona, USA.

*Correspondence to: Jani. C. Ingram, Northern Arizona University, P.O. Box 5698, Flagstaff, AZ 86011 USA. E-mail: jani.ingram@nau.edu.

KEY WORDS: TRADITIONAL ECOLOGICAL KNOWLEDGE, NAVAJO FUNDAMENTAL LAWS, ABANDONED URANIUM MINES, ENVIRONMENTAL JUSTICE, TRADITIONAL KNOWLEDGE HOLDERS.

Human Biology, Winter 2020, v. 92, no. 1, pp. 19–26. doi: 10.13110/humanbiology.92.1.01.

on the Navajo Nation in the 1940s (Brugge et al. 2007). Such exploitation is not restricted to the Navajo Nation; minorities around the world share a similar history (Marbury 1995). Inevitably, poor, ethnic minorities experience firsthand the health issues associated with environmental contaminant exposures.

It is important to know the extent of harm caused by uranium mining. In the past 40 years, numerous illnesses on the Navajo Reservation have been attributed, at least in part, to uranium mining activities, such as kidney disease and a variety of cancers. The former miners, along with their families, were not aware that there were long-term health-related risks associated with uranium mining (Brugge and Goble 2002), illustrating the difficult legacy of uranium mining on the Navajo Reservation.

Five US agencies are involved in the uranium mine cleanup effort on the Navajo Nation: the US Department of Energy (DOE), the Nuclear Regulatory Commission (NRC), the Bureau of Indian Affairs, the US Environmental Protection Agency (EPA), and the Indian Health Service. These five federal agencies are responsible for resolving the abandoned uranium mine issues on the Navajo Reservation. Historically, the Navajo Nation's distrust of federal agencies has been justified. For example, in the 1980s, Jesse Johnson, the director of the Atomic Energy Commission (AEC) Raw Materials Division, ordered Ralph Batie, one of his officials responsible for health and safety, to withhold information from state officials about the health dangers of unventilated uranium mining (Ball 1993: 1–18). Judge Aldon Anderson of the US District Court in Utah wrote that the "AEC's concerns about national security influenced the decision not to warn. The AEC feared that informed miners would flee the mines and thereby threaten the nation's uranium supply" (Ball 1993: 12). This demonstrates that apparent threat to national security was more important than the health threat to miners.

Federal Policy on Abandoned Uranium Mine Cleanup

The initial effort by the US government to address uranium mill tailings came in 1972, when hearings were held on the use of mill tailings in construction projects (Colorado Department of Public Health and Environment 2015: 3). The most extensive reuse of uranium occurred in Grand Junction, Colorado, where uranium tailings were used for concrete, mortar, backfill around foundations, and street pavements (Rael et al. 2000). In the mid-1970s leukemia rates in Grand Junction were twice the average for the state, which was the driver for legislation that resulted in both the Uranium Mill Tailing Radiation Control Act of 1978 (UMTRCA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (commonly referred to as the Superfund). UMTRCA was the first federal policy to deal with environmental contamination and remedial action (Lowenthal 1997). It was originated by the AEC, which under the Energy Reorganization Act of 1974 was split into two parts: the Energy Research and Development Administration and the NRC (Jones 2005). The Energy Research and Development Administration was responsible for nuclear research that involved not only nuclear bombs but also energy; it was combined in 1977 with the Federal Energy Administration to make the DOE.

The UMTRCA guides remediation of the uranium tailings on the Navajo Reservation. The UMTRCA was established to clean up mill tailings and other contaminants at 24 inactive uranium processing sites, as well as approximately 8,000 properties within the designated contaminated boundaries (Portillo 1992). Under the US Code, both uranium mining and mill tailings are defined as the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content [42 USC § 2014 (e)(2); Lowenthal 1997]. The UMTRCA also influenced the creation of the Uranium Mill Tailings Remedial Action (UMTRA) Project, which requires cleanup of abandoned uranium processing sites around the United States. The majority of these sites are in the western states specifically around the Four Corners area on the Colorado Plateau. The UMTRCA comprises Title 1 and Title 2. The Title 1 remedial action program addresses the cleanup and disposal of hazardous materials (mostly uranium mill tailings) at 24 abandoned uranium-processing sites around the United States (Portillo 1992). The UMTRA Project helps remediate the affected sites. Title 2's goal is to clean up and instill proper management of tailings

at processing sites for which commercial operators are still responsible (Portillo 1992). Under Title 2, companies that produce hazardous materials are taxed in order to pay for cleanup of the contaminated sites. Some of the companies involved are still in operation—the Kerr-McGee Corporation and the Vanadium Corporation of America—whereas other, smaller uranium companies dissolved or were bought out by bigger companies.

The UMTRA Project also established a priority list of areas that need to be cleaned up. The list was based not on levels of contamination or quantity of materials involved but on proximity of the material to populated areas (Portillo 1992). Under this priority system, there are 24 designated areas; five are on the Navajo Reservation. More than 521 abandoned uranium mine shafts are now estimated to lie on Navajo land (Brugge and Goble 2002). Unfortunately, some areas were cleaned better than other areas, and today, only a small portion of these abandoned uranium mines have been remediated.

The similarity between UMTRCA and the UMTRA Project is that they both address uranium milling. The difference is that UMTRCA requires three federal agencies, EPA, NRC, and DOE, to address uranium mines, while the UMTRA Program is mostly only under the DOE. The UMTRA Program focuses on 10 states, while UMTRCA addresses the entire United States.

The UMTRCA concentrates only on the actual area of the former mill sites and abandoned uranium mines. The US secretary of energy and the NRC define site boundaries. The duration of cleanup of these contaminated sites is 30 years from the end of mining operations. Uranium is highly mobile via wind and water; thus, the overall contaminated areas are considerably larger than the original designated boundaries. In addition, the designated boundaries usually contain the tailing piles and former mill areas but do not include all of the contamination resulting from the tailings (Portillo 1992). The boundaries of the contaminated areas are still not fenced off from the public and wildlife.

An example is in Cameron, Arizona, in the southwestern region of the Navajo Reservation, where there were numerous open-pit mines. All had reclamation work, but only within the boundaries designated to be contaminated by the uranium mines. However, the ore that was mined in Cameron was transported by truck to the uranium mill in Tuba City, approximately 30 miles north, in northern Arizona, on the Navajo Reservation. The surrounding environment, specifically the road that was used to transport the uranium ore to the uranium mill site, is not addressed under the law.

The UMTRCA allows the EPA to regulate hazardous materials associated with the nuclear industry under several guidelines, such as the Clean Air Act (CAA), the Safe Drinking Water Act (SDWA), and the Comprehensive Environmental Response, Compensation, and Liability Act (Jones 2005). The CAA and SDWA establish allowable limits on how much uranium may be inhaled or ingested by humans. The CAA establishes certain limits on contaminants in the air. Uranium can be distributed by wind; therefore, the CAA addresses uranium dust in the air. Since uranium can be mobilized by water, humans may ingest uranium through contaminated water. The SDWA regulates allowable levels of pollutants in drinking water.

According to Portillo (1992), the UMTRA Program is treating isolated areas in western deserts as dump sites, primarily because the nation's uranium ore deposits, associated mines, and processing sites are in the arid West. However, the scientific communities are aware that the desert is fragile—the delicate desert has a limited amount of surface water available for all life. Once the surface water and groundwater become contaminated, this affects the food web of the desert.

Example of Federal Policy Negative Impact on the Navajo Nation

An example of how a federal policy that was intended to improve life for the Navajo actually was detrimental to the Navajo Nation was the livestock reduction of 1933. In 1893, the commissioner of Indian affairs noticed soil erosion in the western United States due to an overpopulation of livestock (Fonaroff 1963). In 1933 John Collier, President Franklin Roosevelt's commissioner of Indian affairs, passed specific policies targeting livestock reduction (Henderson 1989). This began with the New Deal program focused on soil conservation (Fonaroff 1963). The first policy enacted was the Indian Reorganization Act of 1933, which terminated

the General Allotment Act of 1887 (Dawes Act). Under the Dawes Act, Native Americans lost 90 million acres (Fonaroff 1963). The Indian Reorganization Act helped establish the tribal governments we see today.

The Navajo Nation fell victim to policy development during the New Deal era. Stemming from a lack of understanding of Navajo culture, Collier authorized the slaughtering of livestock that belonged to the Navajo people (Henderson 1989). Collier rationalized the livestock reduction to be beneficial, but it only angered many Navajos and pushed families into poverty (Weisiger 2007). New Deal policies were developed with good intentions; however, these policies were not culturally sensitive to the needs of the Navajo tribe. Those who enact policies that will be implemented for the Navajo Nation, or any other tribe, need to understand the tribal culture first. Without any consultation with the tribe, the policy would not be practical when applied. The policy would face resistance and anger from the tribe. The Navajo livestock reduction is a good example of a negative impact because of a lack of cultural considerations.

Cultural Appropriate Approach

The emphasis of this article is culturally focused policy development using traditional ecological knowledge (TEK). Although it has several definitions, depending on the context in which it is used (Whyte 2013), TEK can be broadly described as Indigenous knowledge that is preserved through oral traditions and cultural expressions; these unwritten laws provide Native Americans with an understanding and respect for the environment (Finn et al. 2017). TEK is learning by observation. Native Americans observe nature, which allows them to teach their younger generations how to interact with their surroundings (Barnhardt and Angayuqaq 2005). These observations are specific for each geographical location, because the climate, vegetation, and wildlife differ. In this sense, TEK is a process that is learned (Berkes et al. 2000; Berkes 2009). This process entails local or traditional practices specific for each geographic location. In this manner, preservation and sustainability are practiced to preserve the environment for future use (Berkes et al. 1995).

Often in Western science, TEK is not acknowledged even though Native Americans have been observing nature for generations. One barrier to the utilization of TEK is that it is not a written but an oral tradition (Huntington 2000). This documentation process causes a barrier to applying TEK. Another obstacle is the inconsistent definition of TEK (Usher 2000). TEK includes knowledge, use, and value of the relationships of the whole environment in a given location. This vague definition causes communication difficulties when trying to apply it to environmental or other issues of interest to tribal communities (Ellis 2005; Stevenson 1996).

When it comes to contamination of communities such as Native American reservations, a risk assessment provides a better understanding of contaminant exposures from the environment. Typically, risk assessment policies do not take into account Native American lifestyles and culture, which can be very different from those of the majority population. To define a risk assessment from a Native American worldview, it must encompass the environment, including land, plants, water, and air (Pierotti and Wildcat 2000). Community, from a Native American perspective, is the interconnection of biota, land, and humans in a specific geographic location. The main concept is the interconnection of each community from a holistic view (Johannes 1993); the human and natural world are not considered apart from each other. The need for a holistic approach in risk assessment in Native American communities should be acknowledged (Arquette et al. 2002). The utilization of TEK to determine risk assessment and therefore to influence policy development related to environmental contamination in Native American communities will more accurately reflect their exposure to the environmental contaminants. The use of TEK for Alaskan Native communities in dealing with uranium issues has also been documented (Wiles et al. 1999).

Navajo Fundamental Laws

In the case of the Navajo Nation, TEK is represented in the Navajo Fundamental Laws, which are a set of traditional laws that have been passed down from generation to generation from time immemorial. Historically, these laws consisted of an oral

tradition, and until recently, none of the teachings was written down.

The Fundamental Laws of Dine', the term Navajo people use to describe themselves, serve as a guide for the Navajo people. They are guiding principles in the Navajo's relation to Mother Earth. These fundamental laws address the Navajo's relationships not only with the environment but also with other living beings. This includes the Navajo's relationships with people, animals, insects, animals that fly, and animals that live in the water (Markstrom and Charley 2003).

The four Fundamental Laws address the relationship with the land, people, natural environmental, and animals: Natural Law, Traditional Law, Customary Law, and Common Law (Austin 2009; Lee and Lee 2012). These laws were given to the Navajo by the Holy People to live by after going through some adversity in the Four Worlds. A summary of the laws is provided in Table 1 (Bobroff 2007).

Table 1. The Fundamental Laws of the Navajo Nation

Law	Description
Natural Law	• Teachings that focus on the four sacred elements (air, light/fire, water, and earth/pollen). • The six sacred mountains to the Navajo Nation must be respected, honored, and protected as the foundation of the Navajo Nation. • The animals, plants, insects, subsurface biota, and animals living in the water have their own laws and have the right to live; this law acknowledges interdependence of all living beings within the environment.
Traditional Law	• The Navajo people have the right to choose their own leaders. • The leaders are chosen based on their wisdom, experience, and communication skills to provide leadership in the best interests of the Navajo Nation. • Navajo elders, medicine men/women, and teachers of Navajo laws are respected and honored. They provide traditional ceremonies, songs, and prayers that are to be protected and preserved and to be taught to future generations.
Customary Law	• Navajo people have a holistic education of values and principles living in balance with the environment. • The K'e (the kinship system) based on the four clans is to be taught to younger generations. • Use the Navajo language to teach to future generations for preservation of the Navajo culture. • The sacred bond of marriage and the unity of family are protected, along with respect for Navajo elders and protecting the environment from abuse.
Common Law	• The knowledge, wisdom, and practices of the Navajo people must be developed and exercised in harmony with the values and principles of all the Navajo Fundamental Laws. • The values and principles of this law must be recognized, respected, honored, and trusted as the motivational guidance for the Navajo people and their leaders in order to cope with the complexities of the changing world.

The Natural Law touches on the four sacred elements; air, fire/light, water, and earth/pollen. These four elements must be respected because they sustain life and therefore must be honored and protected. Mother Earth and Father Sky, in addition to all the animals in between these entities, have a right to exist (Lee 2011), what Western society might refer to as *intrinsic value*. The Navajo Nation was designated as steward of these relatives, as they are a gift from the Creator. Navajos must never disrespect Mother Earth and Father Sky because they do not own their mother or father. This is a traditional teaching that came from many generations and is communicated through oral traditions; it often contradicts policies of dominion of Western nations.

The Traditional Law teaches how the people choose Navajo leaders. Navajo leaders must protect and uphold their duties to protect the Navajo Nation. Initially, medicine people were leaders, since they know about the natural laws and how to restore oneself to others and to nature (Furnish 2008; Lee and Lee 2012). This law is important in implementing policies that help the Navajo tribe. From the Traditional Law come the responsibilities of the three branches of Navajo government (executive, judicial, and legislative). Lastly, this law maintains that Navajo people protect and honor Navajo elders and medicine people.

Customary Law declares that the Navajo people live in balance with all creation. When an imbalance happens between Navajo and nature, harm befalls everyone, including the animals, insects, and vegetation (Markstrom and Charley 2003). The environmental contamination of Navajo lands as a result of uranium mining is an example of breaking the Customary Law. The law addresses a connection with community values (Rosser 2008). The Navajo people must also keep the sacred tradition of *k'e* (linear fluid relationship, such as adopting children), based on the four clans, while descendants are taught the clan system in order to preserve the clan system. In Navajo culture, one's clan is based on a maternal system. That means the child first will have the mother clan. The second clan is the father's clan, third is the maternal grandfather's clan, and lastly the paternal grandfather's clan. The customary law touches on the sacred bound of marriage and family. Navajo must maintain the Navajo language, which is taught to the children in order to preserve it. This law states that there should be no abuse of children and elders.

Lastly, the Common Law states that knowledge and practices must be in harmony with the

Traditional Law. Everything in nature, including all of its inhabitants, is connected, and therefore we must treat Mother Earth and its inhabitants with respect and not take them for granted (Markstrom and Charley 2003; Austin 2009). The world is always changing, nothing remains static, and that is why the Navajo must change to compete in the ever-changing world but must still follow the Navajo Fundamental Laws. These laws acknowledge that the Navajo people learn from other people, but the knowledge must be intertwined with Dine' knowledge.

The Navajo Fundamental Laws go into much more depth with the Navajo elders and traditional knowledge holders and stay within the tribe. An example of how this is used in relation to the abandoned uranium mines involves understanding the level of uranium in the water, soil, and plants (Natural Law). This entails looking at different pathways of exposure because the Navajo people use the whole environment for ceremonies (Natural, Traditional, Customary, and Common Laws). They use plants for medicine and food (Natural, Traditional, and Customary Laws). The Navajo knowledge holders teach their students to recognize the interrelation within an environment (Natural, Traditional, Customary, and Common Laws). All the Navajo Nation Fundamental Laws are applicable in this example. The Navajo respect their environment and recognize the abuse that has occurred with the legacy of abandoned uranium mines. The Navajo Nation has an opportunity to explore the idea of implementing a holistic risk assessment to understand the overall impact on the environment concerning abandoned uranium mines on the Navajo Nation.

Conclusion

Navajo Fundamental Laws are TEK on Navajo land. In developing policies related to the uranium cleanup efforts, the use of TEK on tribal land benefits the Navajo Nation (Lerma 2017). Policy development pertaining to Native American environmental contamination should address the interconnection with nature. Within the Navajo perspective, this would fall under Natural Law within the Navajo Fundamental Laws. The traditional knowledge holders (i.e., medicine men) act as instructors on how the Natural Law is interpreted in terms of the interdependence between human and nature to establish policies. Acknowledgment of these laws, along with implementation, can help create a culturally appropriate policy on environmental contamination on Navajo lands. Using Navajo Fundamental Laws would help establish policy that is more reflective of the cultural practices. It provides a more holistic view on what people use when they practice their traditional culture without putting the public health in jeopardy. It would enable Navajo people to continue practicing their cultural traditions, including dealing with environmental contamination.

Past actions taken by the Navajo Nation include the enactment of the Diné Natural Resources Protection Act of 2005 and the Radioactive Materials Transportation Act of 2012. These two pieces of Navajo Nation legislation prohibit the mining and transportation of radioactive material on Navajo land. Recently, the Navajo Nation also opened the first cancer treatment center the Navajo Reservation to address health needs, which are in part attributable to past uranium mining activity (Nez 2019). Additionally, the Navajo Nation established the Diné Uranium Remediation Advisory Commission in 2018, which includes Navajo scientists, community members, and tribal leaders. The commission consults with traditional knowledge holders such as medicine people on issues related to the uranium mining legacy and cleanup strategies. In 2016, Tronox settlement funds were awarded to the Navajo Nation for cleanup of approximately 50 former mines that were operated by the Kerr-McGee Corporation. These funds are being management by the EPA in collaboration with the Navajo Nation. All these recent actions have empowered the Navajo Nation to influence policy development related to the uranium mine legacy that affects the Navajo. TEK in the form of the Navajo Fundamental Laws has played a role in Navajo life for many generations. It is essential that these laws continue to be used today to provide the basis for Navajo decision making.

ACKNOWLEDGMENTS

We acknowledge Jamie Daisy Purdy, Chad Hamill, and Jalisa Ingram for editing the manuscript. We also thank the Center for Indigenous Environmental Health Research

(National Institute of Environmental Health Sciences grant P50ES026089 and US Environmental Protection Agency grant R836151), National Cancer Institute/Native American Cancer Prevention (U54CA143925), and Native American Research Centers for Health (NARCH) 7 (U261IHS0074-01-01) funded by the Indian Health Service and the National Institutes of Health for support of our work.

Received 5 November 2019; accepted for publication 4 May 2020.

LITERATURE CITED

Arquette, M., M. Cole, K. Cook et al. 2002. Holistic risk-based environmental decision making: A Native perspective. *Environ. Health Perspect.* 110:259–264.

Austin, R. D. 2009. *Navajo Courts and Navajo Common Law: A Tradition of Tribal Self-Governance*. Minneapolis: University of Minnesota Press.

Ball, H. 1993. *Cancer factories: America's tragic quest for uranium self-sufficiency*. Westport, CT: Greenwood Press.

Barnhardt, R., and O. K. Angayuqaq. 2005. Indigenous knowledge systems and Alaska Native ways of knowing. *Anthropol. Educ. Q.* 36:8–23.

Berkes, F. 2009. Indigenous ways of knowing and the study of environmental change. *J. R. Soc. N. Z.* 39:151–156.

Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecol. Appl.* 10:1,251–1,262.

Berkes, F., C. Folke, and M. Gadgil. 1995. Traditional ecological knowledge, biodiversity, resilience and sustainability. In *Biodiversity Conservation: Ecology, Economy and Environment,* vol. 4, C. A. Perrings, K. G. Mäler, C. Folke et al., eds. Dordrecht, NL: Springer, 281–299.

Bobroff, K. 2007. Diné Bi Beenahaz'áanii: Codifying Indigenous consuetudinary law in the 21st century. *Tribal Law J.* 5:1–13. https://lawschool.unm.edu/tlj/volumes/vol5/_dine_bi_beenahazaanii__codifying_indigenous_consuetudinary_law_in_the_21st_century/index.html.

Brugge, D., T. Benally, and E. Yazzie-Lewis. 2007. *The Navajo People and Uranium Mining.* Albuquerque: University of New Mexico Press.

Brugge, D., and R. Goble. 2002. The history of uranium mining and the Navajo people. *Am. J. Public Health* 92:1,410–1,419.

Colorado Department of Public Health and Environment. 2015. *Uranium mill tailings management plan for managing Title I uranium mill tailings encountered during construction activities in western Colorado*. https://www.cityofmontrose.org/DocumentCenter/View/33506/17-018-Uranium-Mill-Tailings-Management-Plan?bidId= .

Cutter, S. L. 1995. Race, class and environmental justice. *Prog. Hum. Geogr.* 19:111–122.

Eichstaedt, P. H. 1994. *If You Poison Us: Uranium and Native Americans*. Santa Fe, NM: Red Crane Books.

Ellis, S. C. 2005. Meaningful consideration? A review of traditional knowledge in environmental decision making. *Arctic* 58:66–77.

Finn, S., M. Herne, and D. Castille. 2017. The value of traditional ecological knowledge for the environmental health sciences and biomedical research. *Environ. Health Perspect.* 125:085006. doi:10.1289/EHP858.

Fonaroff, L. S. 1963. Conservation and stock reduction on the Navajo tribal range. *Geogr. Rev.* 53:200–223.

Furnish, D. B. 2008. The Navajo Nation: A three-ingredient mix. *Electron. J. Comp. Law* 12:1–27.

Henderson, E. 1989. Navajo livestock wealth and the effects of the stock reduction program of the 1930s. *J. Anthropol. Res.* 45:379–403.

Huntington, H. P. 2000. Using traditional ecological knowledge in science: Methods and applications. *Ecol. Appl.* 10:1,270–1,274.

Johannes, R. E. 1993. Integrating traditional ecological knowledge and management with environmental impact assessment. In *Traditional Ecological Knowledge: Concepts and Cases*, J. T. Inglis, ed. Ottowa: Canadian Museum of Nature and International Development Research Centre, 33–39.

Jones, C. G. 2005. A review of the history of U.S. radiation protection regulations, recommendations, and standards. *Health Phys.* 88:105–124.

Lee, L. L. 2011. Decolonizing the Navajo Nation: The lessons of the naabaahii. Paper presented at the 42nd Annual National Indian Education Association Convention and Tradeshow, Albuquerque, NM, 27–30 October. https://files.eric.ed.gov/fulltext/ED528280.pdf.

Lee, L. L., and T. S. Lee. 2012. Navajo cultural autonomy. *Int. J. Soc. Lang.* 2012:119–126.

Lerma, M. 2017. *Guided by the Mountains: Navajo Political Philosophy and Governance.* Oxford: Oxford University Press.

Lowenthal, M. D. 1997. *Radioactive-waste classification in the United States: History and current predicaments.* Livermore, CA: Lawrence Livermore National Laboratory, U.S. Department of Energy.

Marbury, H. J. 1995. Hazardous waste exportation: The global manifestation of environmental racism. *Vanderbilt J. Transnatl. Law* 28:251–294.

Markstrom, C. A., and P. H. Charley. 2003. Psychological

effects of technological/human-caused environmental disasters: Examination of the Navajo and uranium. *Am. Indian Alsk. Native Ment. Health Res.* 11:19–45.

Navajo AML/UMTRA Department. n.d. *Abandoned Uranium Mines* (*AUM*) *Projects on the Navajo Nation.* https://www.aml.navajo-nsn.gov/AUM (accessed January 30, 2020).

Nez, J. 2019. *Written Statement of the Navajo Nation Prepared for the House Committee on Natural Resources Subcommittee on Energy and Mineral Resources on Uranium Mining: Contamination and Criticality and H.R. 3405, the Uranium Classification Act of 2019*. Window Rock, AZ: Navajo Nation Office of the President and Vice President.

Pierotti, R., and D. Wildcat. 2000. Traditional ecological knowledge: The third alternative (commentary). *Ecol. Appl.* 10:1,333–1,340.

Portillo, R. S. 1992. Mill tailings remediation: The UMTRA Project. In: *Deserts as dumps? The disposal of hazardous materials in arid ecosystems*, C. C. Reith and B. M. Thomson, eds. Albuquerque: University of New Mexico Press, 281–302.

Quartaroli, M. 2002. "Leetso," the yellow monster: Uranium mining on the Colorado Plateau. In *Canyons, cultures and environmental change: An introduction to the land-use history of the Colorado Plateau*, J. Grahame and T. Sisk, eds. Northern Arizona University. https://web.archive.org/web/20051224012212/http://www.cpluhna.nau.edu/Change/uranium.htm

Rael, G. J., S. W. Cox, and E. W. Artiglia. 2000. Completion of the uranium mill tailings remedial project and cleanup of the former mill site at Grand Junction, Colorado. In: *Restoration of environments with radioactive residues: Papers and discussions: Proceedings of an international symposium organized by the International Atomic Energy Agency and held in Arlington, Virginia, USA, 29 November–3 December 1999.* IAEA-SM-359/3D.4. Vienna: International Atomic Energy Agency, 459–475.

Rosser, E. 2008. Customary law: The way things were, codified. *Tribal Law J*. 8:18–33.

Stevenson, M. G. 1996. Indigenous knowledge in environmental assessment. *Arctic* 49:278–291.

Usher, P. J. 2000. Traditional ecological knowledge in environmental assessment and management. *Arctic* 53:101–212. doi:10.14430/arctic849.

Weisiger, M. 2007. Gendered injustice: Navajo livestock reduction in the New Deal era. *West. Hist. Q.* 38:437–455.

Whyte, K. P. 2013. On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecol. Process.* 2:1–12.

Wiles, A., J. McEwen, and M. H. Sadar. 1999. Use of traditional ecological knowledge in environmental assessment of uranium mining in the Athabasca Saskatchewan. *Impact Assess. Proj. Appraisal* 17:107–114.